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MK University, Patan
Faculty of Engineering Technology,
Department of Mechanical Engineering

DIPLOMA (MECHANICAL ENGINEERING) SEM-I									
SR NO.	COURSE TYPE	COURSE CODE	COURSE NAME	LECTURE (HRS.)/WEEK	PRACTICAL (HRS.)/WEEK	CREDITS	EXAMINATION		TOTAL MARKS
							INTERNAL	EXTERNAL	
1	MAJOR	DME101	ENGINEERING MATHEMATICS-I	4	0	4	40	60	100
2	MAJOR	DME102	ENGINEERING PHYSICS	4	2	6	90	60	150
3	MAJOR	DME103	ENGINEERING CHEMISTRY	4	2	6	90	60	150
4	MAJOR	DME104	ENGINEERING GRAPHICS & CAD	4	2	6	90	60	150
5	MINOR	DME105	WORKSHOP PRACTICE	0	2	2	50	00	50
TOTAL				16	8	24	360	240	600

DIPLOMA (MECHANICAL ENGINEERING) SEM-II									
SR NO.	COURSE TYPE	COURSE CODE	COURSE NAME	LECTURE (HRS.)/WEEK	PRACTICAL (HRS.)/WEEK	CREDITS	EXAMINATION		TOTAL MARKS
							INTERNAL	EXTERNAL	
1	MAJOR	DME201	ENGINEERING MATHEMATICS-II	4	0	4	40	60	100
2	MAJOR	DME202	APPLIED MECHANICS	4	2	6	90	60	150
3	MAJOR	DME203	THERMAL ENGINEERING	4	2	6	90	60	150
4	MINOR	DME204	MATERIAL SCIENCE & ENGINEERING	4	2	6	90	60	150
5	SEC	DME205	COMMUNICATION SKILL	2	0	2	00	50	50
TOTAL				18	6	24	310	290	600

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DIPLOMA (MECHANICAL ENGINEERING) SEM-III									
SR NO.	COURSE TYPE	COURSE CODE	COURSE NAME	LECTURE (HRS.)/ WEEK	PRACTICAL (HRS.)/ WEEK	CREDITS	EXAMINATION		TOTAL MARKS
							INTERNAL	EXTERNAL	
1	MAJOR	DME301	STRENGTH OF MATERIALS	4	2	6	90	60	150
2	MAJOR	DME302	MANUFACTURING PROCESS-I	4	2	6	90	60	150
3	MAJOR	DME303	FLUID MECHANICS & HYDRAULIC MACHINES	4	2	6	90	60	150
4	MINOR	DME304	INDUSTRIAL VISIT REPORT	0	2	2	50	00	50
5	IKS	DME305	IKS-ANNCIENT INDIAN ENGINEERING PRACTICE	0	2	2	50	00	50
TOTAL				12	10	22	370	180	550

DIPLOMA (MECHANICAL ENGINEERING) SEM-IV									
SR NO.	COURSE TYPE	COURSE CODE	COURSE NAME	LECTURE (HRS.)/ WEEK	PRACTICAL (HRS.)/ WEEK	CREDITS	EXAMINATION		TOTAL MARKS
							INTERNAL	EXTERNAL	
1	MAJOR	BTME401	MANUFACTURING PROCESS-II	4	2	6	90	60	150
2	MAJOR	BTME402	MECHANICAL MEASUREMENTS & METHDOLOGY	4	2	6	90	60	150
3	MAJOR	BTME403	COMPUTER FUNDAMENTALS & PROGRAMMING	4	0	4	40	60	100
4	MINOR	BTME404	RENEWABLE ENERGY SYSTEMS	4	0	4	40	60	100
5	VAC	BTME405	ENVIRONMENTAL SCIENCE	2	0	2	00	50	50
TOTAL				18	4	22	260	290	550

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DIPLOMA (MECHANICAL ENGINEERING) SEM-V									
SR NO.	COURSE TYPE	COURSECODE	CORSENAME	LECTURE (HRS.)/ WEEK	PRACTICAL (HRS.)/WEEK	CREDITS	EXAMINATION		TOTAL MARKS
							INTERNAL	EXTERNAL	
1	MAJOR	DME501	HEAT TRANSFER	4	2	6	90	60	150
2	MAJOR	DME502	MACHINE DESIGN	4	0	4	40	60	100
3	MAJOR	DME503	CAD/CAM	4	2	6	90	60	150
4	MINOR	DME504	INDUSTRIAL ENGINEERING MANAGEMENT	4	0	4	40	60	100
5	SEC	DME506	MIN PROJECT	0	2	2	50	00	50
TOTAL				16	6	22	310	240	550

DIPLOMA (MECHANICAL ENGINEERING) SEM-VI									
SR NO.	COURSE TYPE	COURSECODE	CORSENAME	LECTURE (HRS.)/ WEEK	PRACTICAL (HRS.)/WEEK	CREDITS	EXAMINATION		TOTAL MARKS
							INTERNAL	EXTERNAL	
1	MAJOR	DME601	AUTOMOBILE ENGINEERING	4	2	6	90	60	150
2	MAJOR	DME602	MAINTENANCE ENGINEERING	4	2	6	90	60	150
3	MAJOR	DME603	INDUSTRY 4.O & IOT	4	2	6	90	60	150
4	MINOR	DME604	DIPLOMA PROJECT	0	6	6	150	00	150
TOTAL				12	12	24	420	180	600

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SEMESTER-I

COURSE CODE: DME101

COURSE NAME: ENGINEERING MATHEMATICS-I

Course Objectives:

- To develop foundational mathematical skills essential for mechanical engineering applications
- To apply algebraic, trigonometric, and calculus concepts to solve engineering problems
- To interpret and analyze data using statistical methods
- To build problem-solving abilities through applied mathematics
- To prepare students for advanced engineering mathematics in subsequent semesters

Course Outcomes: At the end of the course students shall be able to

CO1	**Solve** algebraic equations and apply them to engineering problems
CO2	**Apply** trigonometric functions to analyze mechanical systems
C03	**Perform** basic differentiation and integration relevant to engineering applications
C04	**Analyze** data using measures of central tendency and dispersion

Unit	Content	Credit	Weightage
I	**Algebra and Trigonometry** **Topics:** • **Algebra:** Quadratic equations, simultaneous linear equations (2 and 3 variables) • Arithmetic and geometric progressions • **Trigonometry:** Trigonometric ratios, identities, compound angles • Heights and distances (engineering applications) • Complex numbers: basics and operations • **Applications:** Simple harmonic motion, projectile motion, force resolution	1	25%

II	**Differential Calculus**
	Topics:
	• Functions, limits, and continuity
	• Derivatives: Standard formulas
	• Rules of differentiation: Product, quotient, chain rule
	• Applications of derivatives:
	  ○ Rate of change (velocity, acceleration)
	  ○ Maxima and minima (optimization problems)
	  ○ Tangents and normals
	• Partial differentiation (introduction)
	• **Applications:** Optimization in design, motion analysis, slope of curves
		1	25%

III	**Integral Calculus** **Topics:** • Indefinite integrals: Standard formulas	1	25%

	• Methods of integration: Substitution, integration by parts
	• Definite integrals and properties
	• Applications of integration:
	  ○ Area under curves
	  ○ Volume of solids of revolution
	  ○ Center of gravity/centroid (basic concepts)
	• **Applications:** Area calculation in engineering drawings, volume of tanks/containers		

IV	**Statistics and Probability** **Topics:** • **Statistics:** Data classification, frequency distribution • Measures of central tendency: Mean, median, mode • Measures of dispersion: Range, standard deviation, variance • Graphical representation: Histogram, frequency polygon, ogive • **Probability:** Basic concepts, addition and multiplication theorems • **Applications:** Quality control, measurement analysis, manufacturing data interpretation	1	25%

Textbooks:

- Primary: *Engineering Mathematics* — NP Bali & Dr. Manish Goyal
- Primary: *A Textbook of Engineering Mathematics* — B.S. Grewal

Reference books:

- *Advanced Engineering Mathematics* — H.K. Das
- *Engineering Mathematics* — D. G. Gupta
- *Basic Technical Mathematics with Calculus* — Allyn J. Washington
- *Mathematics for Mechanical Engineering* — B.V. Ramana

Online Platforms:

1. NPTEL Videos: "Basic Course in Mathematics" for engineering
2. Coursera: "Pre-Calculus" by University of California, Irvine

COURSE CODE: DME102

COURSE NAME: ENGINEERING PHYSICS

Course Objectives:

- To understand fundamental physics principles relevant to mechanical engineering
- To apply physics concepts to solve practical engineering problems
- To develop skills in measurement, experimentation, and data analysis
- To correlate theoretical physics with mechanical systems and applications
- To build foundation for advanced engineering courses

Course Outcomes: At the end of the course students shall be able to

CO1	**Apply** mechanics principles to analyze forces, motion, and energy in mechanical systems
CO2	**Explain** thermal physics concepts relevant to heat engines and refrigeration
C03	**Demonstrate** understanding of optics and acoustics in

	engineering contexts
C04	**Perform** measurements using physical instruments and analyze experimental data

Unit	Content	Credit	Weightage
I	**Mechanics & Properties of Matter** **Topics:** • Scalars and vectors, force resolution, moment of force • Laws of motion, friction, work, energy, power • Circular motion, centripetal force • Elasticity: Stress, strain, Hooke's law, Young's modulus • Surface tension and viscosity (basic concepts) • **Applications:** Machine design, material strength, fluid mechanics basics	1	25%
II	**Thermal Physics & Thermodynamics** **Topics:** • Heat and temperature, thermal expansion • Calorimetry, specific heat capacity • Laws of thermodynamics (zeroth, first, second) • Heat transfer: conduction, convection, radiation • Kinetic theory of gases (basic) • **Applications:** Heat engines, refrigeration, insulation materials	1	25%
III	**Waves, Optics & Acoustics** **Topics:** • Simple harmonic motion, wave motion • Sound: characteristics, intensity, Doppler effect • Ultrasonics and applications • Reflection, refraction, lenses, optical instruments • Fiber optics (basic principles) • **Applications:** Machine vibration, NDT, optical measurements, noise control	1	25%
IV	**Modern Physics & Material Science** **Topics:** • Quantum physics basics: photons, matter waves • Lasers: principles, types, applications • Semiconductors: basics • Superconductivity (elementary concepts) • Nanotechnology introduction • **Applications:** Laser machining, sensors, advanced materials	1	25%

Textbooks:

- Primary: *Engineering Physics* — D. R. Khanna & H. N. Srivastava
- Primary: *Engineering Physics* — R. K. Gaur & S. L. Gupta

Reference books:

- *Fundamentals of Physics* — Halliday, Resnick & Walker
- *Concepts of Physics* — H. C. Verma

- *Engineering Physics* — M. N. Avadhanulu & P. G. Kshirsagar
- *Practical Physics* — C. L. Arora

Online Platforms:

- SWAYAM/NPTEL: "Engineering Physics" courses by IITs/NITs

PRACTICAL LIST:

Section A: Mechanics

1. Vernier Calipers & Screw Gauge: Measurement of dimensions of given objects
2. Simple Pendulum: Determination of 'g' and study of laws of pendulum
3. Young's Modulus: By Searle's method or cantilever
4. Coefficient of Friction: Using inclined plane
5. Force Table: Verification of law of parallelogram of forces

Section B: Thermal Physics

6. Specific Heat Capacity: Of solid/liquid using calorimeter
7. Thermal Conductivity: Of good conductor (Searle's apparatus)
8. Mechanical Equivalent of Heat: Using Joule's calorimeter
9. Coefficient of Linear Expansion: Using optical lever

Section C: Waves & Optics

10. Sonometer: Verification of laws of vibrating strings
11. Melde's Experiment: Transverse and longitudinal modes
12. Compound Pendulum: Determination of 'g' and radius of gyration
13. Optical Bench: Focal length of convex lens
14. Prism: Refractive index using spectrometer

Section D: Modern Physics

15. LASER: Determination of wavelength using diffraction grating
16. Photoelectric Effect: Verification of Einstein's equation
17. PN Junction Diode: Characteristics
18. Thermistor: Temperature-resistance characteristics

COURSE CODE: DME103

COURSE NAME: ENGINEERING CHEMISTRY

Course Objectives:

- To provide fundamental knowledge of chemistry relevant to mechanical engineering applications
- To understand material properties, corrosion, fuels, and lubricants from chemical perspective
- To develop skills in chemical analysis, quality control, and material testing
- To correlate chemical principles with mechanical systems and manufacturing processes
- To build foundation for materials science, metallurgy, and environmental engineering

Course Outcomes: At the end of the course students shall be able to

CO1	**Explain** water treatment processes for industrial applications
CO2	**Analyze** properties of fuels and lubricants used in mechanical systems
C03	**Identify** corrosion mechanisms and prevention methods
C04	**Apply** principles of electrochemistry to batteries and corrosion control

Unit	Content	Credit	Weightage

I	**Water Chemistry & Treatment** **Topics:** • Water impurities: hardness, alkalinity, pH • Water softening methods: lime-soda, ion exchange • Boiler feed water treatment: scale and sludge formation, prevention • Cooling water treatment • Drinking water standards • **Applications:** Boiler operations, cooling systems, industrial water supply	1	25%
II	**Fuels & Combustion** **Topics:** • Classification of fuels: solid, liquid, gaseous • Calorific value determination: bomb calorimeter • Solid fuels: coal analysis (proximate & ultimate) • Liquid fuels: petroleum refining, petrol, diesel, octane/cetane number • Gaseous fuels: LPG, CNG, biogas • Combustion calculations • **Applications:** IC engines, furnaces, power generation	1	25%
III	**Lubricants & Corrosion** **Topics:** • Lubrication: mechanisms, types of lubricants • Properties: viscosity index, flash point, pour point • Additives in lubricants • Corrosion: types, mechanisms (electrochemical) • Factors affecting corrosion • Corrosion prevention methods • **Applications:** Machine maintenance, automotive, industrial equipment	1	25%
IV	**Engineering Materials & Polymers** **Topics:** • Cement: composition, setting and hardening • Refractories: properties, classification • Polymers: addition, condensation, engineering plastics • Composite materials: introduction • Batteries: primary, secondary, fuel cells • **Applications:** Construction materials, polymers in engineering, energy storage	1	25%

Textbooks:

- Primary: *Engineering Chemistry* — Jain & Jain
- Primary: *Engineering Chemistry* — Dr. O. P. Verma

Reference books:

- *A Textbook of Engineering Chemistry* — S. S. Dara & S. S. Umare
- *Engineering Chemistry* — R. P. Mani & K. N. Mishra
- *Chemistry for Engineering Students* — B. S. Jai Prakash & R. Venugopal
- *Applied Chemistry* — H. D. Gesser

Online Platforms:

- SWAYAM/NPTEL: "Engineering Chemistry" courses by IITs
- Khan Academy: Chemistry fundamentals
- MERLOT: Chemistry learning materials

PRACTICAL LIST:

Section A: Water Analysis

1. Determination of Hardness: By EDTA titration method
2. Alkalinity Determination: Using acid-base titration
3. pH Measurement: Using pH meter/universal indicator
4. Chloride Content: By argentometric method

Section B: Fuels & Lubricants

5. Viscosity Measurement: Using Ostwald viscometer/Redwood viscometer
6. Flash Point Determination: Using Abel/Pensky Martens apparatus
7. Calorific Value: Bomb calorimeter demonstration
8. Saponification Value: Of oil sample

Section C: Corrosion & Electrochemistry

9. Corrosion Rate Measurement: Weight loss method
10. Galvanic Series Determination
11. Electroplating: Copper plating on iron
12. EMF Measurement: Of simple galvanic cell

Section D: Materials & Polymers

13. Cement Setting Time: Initial and final setting time
14. Polymer Identification Tests
15. Preparation of Polymer: Phenol-formaldehyde/Bakelite
16. Refractory Properties: Porosity, thermal shock resistance

COURSE CODE: DME104

COURSE NAME: ENGINEERING GRAPHICS AND CAD

Course Objectives:

- To develop skills in engineering drawing and visualization
- To understand and apply standards in technical drawing (BIS/ISO)
- To master basic CAD software for 2D drawing creation
- To prepare production-ready engineering drawings
- To bridge manual drafting skills with digital CAD competence

Course Outcomes: At the end of the course students shall be able to

CO1	**Create** engineering drawings using manual drafting instruments
CO2	**Apply** BIS/ISO standards in dimensioning and tolerancing
C03	**Develop** orthographic projections from pictorial views
C04	**Generate** 2D drawings using CAD software

Unit	Content	Credit	Weightage
I	**Fundamentals & Manual Drafting** **Topics:** • Drawing instruments and their uses	1	25%

	• BIS/ISO conventions and standards • Lettering, line types, dimensioning rules • Geometric constructions • Scales: plain, diagonal, vernier • **Practical:** Manual drafting exercises, sheet layout		
II	**Projections & Views** **Topics:** • Orthographic projections (First angle vs Third angle) • Projection of points, lines, and planes • Projection of solids: prism, pyramid, cylinder, cone • Sectional views: full, half, offset sections • Auxiliary views • **Practical:** Drawing orthographic views from isometric	1	25%
III	**CAD Fundamentals** **Topics:** • Introduction to CAD: advantages, applications • AutoCAD interface: workspace, toolbars, commands • Basic drawing commands: Line, Circle, Arc, Polygon • Modify commands: Copy, Move, Rotate, Mirror, Array • Layers, colors, linetypes • Dimensioning and annotation in CAD	1	25%
IV	**Applications & Advanced CAD** **Topics:** • Blocks and attributes • Hatching and pattern filling • Plotting and printing to scale • Introduction to 3D modeling basics • Industrial drawing examples: machine parts • **Practical:** Complete drawing projects	1	25%

Textbooks:

- Primary: *Engineering Drawing* — N. D. Bhatt
- Primary: *Engineering Drawing with AutoCAD* — Goutam Pohit & Goutam Ghosh

Reference books:

- *Engineering Drawing* — Basant Agrawal & C. M. Agrawal
- *A Textbook of Engineering Drawing* — R. K. Dhawan
- *AutoCAD for Engineers and Designers* — Sham Tickoo
- *Machine Drawing* — K. L. Narayana & P. Kannaiah

Online Platforms:

- SWAYAM/NPTEL: "Engineering Drawing" courses by IITs
- Coursera: "Autodesk CAD/CAM/CAE" specialization

PRACTICAL LIST:

Section A: Manual Drafting (Drawing Sheets)

1. Sheet 1: Lines, lettering, dimensioning practice
2. Sheet 2: Geometric constructions
3. Sheet 3: Orthographic projections of simple solids

4. Sheet 4: Sectional views of machine parts
5. Sheet 5: Development of surfaces

Section B: CAD Exercises - Basic

6. CAD-1: AutoCAD interface familiarization
7. CAD-2: Basic shapes using drawing commands
8. CAD-3: Modification exercises
9. CAD-4: Layer management exercise
10. CAD-5: Dimensioning practice

Section C: CAD Exercises - Intermediate

11. CAD-6: Orthographic projections in CAD
12. CAD-7: Sectional views in CAD
13. CAD-8: Creating blocks and attributes
14. CAD-9: Plotting and printing
15. CAD-10: Title block creation

Section D: Project Work

16. Project 1: Machine component drawing (manual)
17. Project 2: Same component drawing in CAD
18. Project 3: Assembly drawing with parts list
19. Project 4: Complete drawing set: part + assembly
20. Portfolio: Compilation of best work

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SEMESTER-II

COURSE CODE: DME201

COURSE NAME: ENGINEERING MATHEMATICS-II

Course Objectives:

- To build advanced mathematical skills for engineering problem-solving
- To apply differential equations to model mechanical systems
- To understand vector algebra and its applications in mechanics
- To develop skills in numerical methods for engineering computations
- To prepare mathematical foundation for subjects like Mechanics, Thermodynamics, and Machine Design

Course Outcomes: At the end of the course students shall be able to

CO1	**Solve** ordinary differential equations relevant to engineering systems
CO2	**Apply** vector algebra to analyze forces and motions in 3D space
C03	**Perform** numerical computations using interpolation, differentiation, and integration methods
C04	**Analyze** data using probability distributions and statistical methods

Unit	Content	Credit	Weightage
I	**Differential Equations** **Topics:** • First order differential equations: variable separable, homogeneous, exact • Linear differential equations of first order • Applications: Newton's law of cooling, growth and decay, simple circuits • Second order linear differential equations with constant coefficients • Complementary function and particular integral methods • **Applications:** Spring-mass systems, electrical circuits, vibration analysis	1	25%
II	**Vector Algebra & 3D Geometry** **Topics:** • Vectors: dot product, cross product, scalar triple product • Vector differentiation • Gradient, divergence, curl (basic concepts) • Lines and planes in 3D space • Direction cosines and ratios • **Applications:** Force analysis, moment of force, work done by force	1	25%
III	**Numerical Methods** **Topics:** • Solution of algebraic equations: Bisection method,	1	25%

	Newton-Raphson method • Interpolation: Newton's forward and backward difference formulas • Numerical differentiation and integration • Trapezoidal rule and Simpson's rules • **Applications:** Root finding in design equations, area calculations, data analysis		
IV	**Probability & Laplace Transforms** **Topics:** • **Probability:** Basic concepts, addition and multiplication theorems • Random variables, probability distributions (Binomial, Poisson, Normal) • Mean, variance, standard deviation • **Laplace Transforms:** Definition, basic transforms • Properties: linearity, shifting, differentiation • Application to differential equations • **Applications:** Quality control, reliability analysis, system dynamics	1	25%

Textbooks:

- Primary: *Higher Engineering Mathematics* — B.S. Grewal
- Primary: *Engineering Mathematics* — NP Bali & Dr. Manish Goyal

Reference books:

- *Advanced Engineering Mathematics* — H.K. Das
- *Numerical Methods* — S.S. Sastry
- *Probability and Statistics for Engineers* — Dr. J. Ravichandran
- *Mathematical Methods* — B.V. Ramana

Online Platforms:

- NPTEL Videos: "Differential Equations for Engineers"
- Khan Academy: Complete probability and statistics
- MIT OCW: "Single Variable Calculus" continuation
- Coursera: "Introduction to Numerical Methods"

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COURSE CODE: DME202

COURSE NAME: APPLIED MECHANICS

Course Objectives:

- To understand fundamental principles of mechanics and their applications in engineering
- To analyze forces, moments, and equilibrium in mechanical systems
- To study kinematics and dynamics of particles and rigid bodies
- To apply concepts of friction, work, energy, and power to mechanical systems
- To develop problem-solving skills for engineering mechanics applications

Course Outcomes: At the end of the course students shall be able to

CO1	**Apply** principles of statics to analyze equilibrium of forces
CO2	**Calculate** centroids, center of gravity, and moments of inertia
C03	**Solve** problems in kinematics: displacement, velocity, acceleration
C04	**Analyze** dynamic systems using Newton's laws and energy methods

Unit	Content	Credit	Weightage
I	**Statics - Forces & Equilibrium** **Topics:** • Introduction to mechanics: statics and dynamics • System of forces: coplanar concurrent, parallel, non-concurrent • Resolution and composition of forces • Moment of a force, couple, Varignon's theorem • Equilibrium of forces: conditions, free body diagrams • **Applications:** Truss analysis, machine component design	1	25%
II	**Centroid, Friction & Virtual Work** **Topics:** • Centroid and center of gravity: simple and composite areas • Moment of inertia: area moment, parallel axis theorem • Friction: laws of friction, angle of repose, wedge friction • Belt friction: flat and V-belts • Virtual work principle • **Applications:** Structural design, machine stability, belt drives	1	25%
III	**Kinematics** **Topics:** • Rectilinear motion: displacement, velocity, acceleration • Curvilinear motion: projectile motion • Relative motion • Rotation: angular displacement, velocity, acceleration	1	25%

	• Simple harmonic motion • **Applications:** Mechanism analysis, vehicle dynamics, vibration basics		
IV	**Dynamics** **Topics:** • Newton's laws of motion: application to engineering problems • Work, energy, power: definitions and applications • Impulse and momentum: conservation principles • Collision of elastic bodies: direct and oblique impact • Introduction to vibration: free vibrations • **Applications:** Impact loading, energy calculations, machine dynamics	1	25%

Textbooks:

- Primary: *Engineering Mechanics* — S. S. Bhavikatti & K. G. Rajashekarappa
- Primary: *Applied Mechanics* — R. S. Khurmi

Reference books:

- *Engineering Mechanics: Statics & Dynamics* — I. H. Shames
- *Vector Mechanics for Engineers* — Beer & Johnston
- *Engineering Mechanics* — D. S. Kumar
- *Problems in Engineering Mechanics* — S. P. Timoshenko & D. H. Young

Online Platforms:

- SWAYAM/NPTEL: "Engineering Mechanics" courses by IITs

PRACTICAL LIST:

Section A: Statics Experiments

1. Law of Parallelogram of Forces: Verification using force table
2. Law of Polygon of Forces: Experimental verification
3. Jib Crane Analysis: Forces in members using graphical method
4. Simple Truss Analysis: Using method of joints

Section B: Friction & Center of Gravity

5. Coefficient of Friction: Using inclined plane
6. Angle of Repose: Determination for different materials
7. Center of Gravity: Of irregular lamina using plumb line method
8. Moment of Inertia: Compound pendulum method

Section C: Kinematics Experiments

9. Projectile Motion: Study using projectile apparatus
10. Simple Pendulum: Determination of 'g' and laws verification
11. Flywheel: Moment of inertia determination
12. Atwood's Machine: Verification of laws of motion

Section D: Dynamics & Impact

13. Conservation of Energy: Using inclined track and trolley
14. Coefficient of Restitution: Using ball drop test
15. Impact of Bodies: Direct central impact demonstration
16. Spring Constant: Determination using Hooke's law

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COURSE CODE: DME203

COURSE NAME: THERMAL ENGINEERING

Course Objectives:

- To understand fundamental laws of thermodynamics and their applications
- To analyze properties of steam, gas, and air cycles
- To study working principles of boilers, IC engines, and refrigeration systems
- To apply heat transfer principles to engineering systems
- To develop skills in thermal equipment testing and performance evaluation

Course Outcomes: At the end of the course students shall be able to

CO1	**Apply** laws of thermodynamics to thermal systems
CO2	**Analyze** steam and gas power cycles
C03	**Evaluate** performance of boilers, IC engines, and compressors
C04	**Explain** working of refrigeration and air conditioning systems

Unit	Content	Credit	Weightage
I	**Basic Thermodynamics** **Topics:** • Thermodynamic systems, properties, processes • Zeroth, first, and second laws of thermodynamics • Pure substances: P-v-T diagrams, steam tables • Perfect gas laws, specific heats • **Applications:** Energy balance in thermal systems	1	25%
II	**Steam Engineering & Boilers** **Topics:** • Formation of steam, steam tables, Mollier chart • Properties of steam, dryness fraction • Rankine cycle, reheat, regeneration • Boilers: types, mountings, accessories • Boiler efficiency, performance calculations • **Applications:** Power plant operations, industrial heating	1	25%
III	**Internal Combustion Engines** **Topics:** • Classification of IC engines: SI and CI engines • Engine components and terminology • Valve timing diagrams, fuel supply systems • Performance parameters: indicated power, brake power, efficiencies • Emission control basics • **Applications:** Automotive engines, power generation	1	25%
IV	**Refrigeration & Heat Transfer** **Topics:** • Vapor compression refrigeration cycle • Refrigerants: properties, environmental impact • Psychrometry: properties of air, psychrometric chart • Modes of heat transfer: conduction, convection, radiation	1	25%

	• Heat exchangers: types and applications • **Applications:** Cooling systems, HVAC, process heating		

Textbooks:

- Primary: *Thermal Engineering* — R. K. Rajput
- Primary: *Engineering Thermodynamics* — P. K. Nag

Reference books:

- *Thermodynamics: An Engineering Approach* — Yunus Cengel & Michael Boles
- *Heat and Mass Transfer* — R. K. Rajput
- *Internal Combustion Engines* — V. Ganesan
- *Refrigeration and Air Conditioning* — C. P. Arora

Online Platforms:

- SWAYAM/NPTEL: "Thermodynamics" and "Heat Transfer" courses by IITs
- edX: "Thermodynamics" by IIT Bombay

PRACTICAL LIST:

Section A: Thermodynamics

1. Boyle's Law Verification: Using Boyle's law apparatus
2. Joule's Experiment: Mechanical equivalent of heat
3. Steam Calorimeter: Determination of dryness fraction
4. COP of Heat Pump: Performance evaluation

Section B: Steam & Boilers

5. Boiler Mountings: Identification and function study
6. Steam Turbine: Demonstration and performance test
7. Flash & Separating Calorimeter: Dryness fraction determination
8. Boiler Efficiency: Using direct and indirect methods

Section C: IC Engines

9. Valve Timing Diagram: For 4-stroke petrol/diesel engine
10. Engine Performance Test: Using engine test rig
11. Morse Test: For multi-cylinder engines
12. Exhaust Gas Analyzer: Emission measurement

Section D: Refrigeration & Heat Transfer

13. VCR Cycle: Study using refrigeration test rig
14. Air Conditioning Test Rig: Performance evaluation
15. Heat Transfer Apparatus: Conduction through composite wall
16. Heat Exchanger: Parallel and counter flow study

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ESTABLISHED BY THE GUJARAT GOVT. **RECOGNIZED BY UGC UNDER SECTION 2(f) OF UGC ACT,1956**

COURSE CODE: DME204

COURSE NAME: MATERIAL SCIENCE AND ENGINEERING

Course Objectives:

- To understand fundamental concepts of material structure and properties
- To classify engineering materials based on properties and applications
- To study heat treatment processes and their effects on material properties
- To learn testing methods for evaluating mechanical properties
- To apply material selection principles for engineering applications

Course Outcomes: At the end of the course students shall be able to

CO1	**Classify** engineering materials based on composition and properties
CO2	**Explain** crystal structures and defects in materials
C03	**Apply** heat treatment processes to modify material properties
C04	**Perform** basic material testing and interpret results

Unit	Content	Credit	Weightage
I	**Fundamentals of Materials** **Topics:** • Classification of engineering materials: metals, polymers, ceramics, composites • Atomic structure and bonding: ionic, covalent, metallic • Crystal structures: BCC, FCC, HCP, crystal imperfections • Phase diagrams: binary systems, lever rule • **Applications:** Material selection basics	1	25%
II	**Mechanical Properties & Testing** **Topics:** • Mechanical properties: strength, hardness, toughness, ductility, brittleness • Stress-strain diagrams for ductile and brittle materials • Hardness testing: Brinell, Rockwell, Vickers • Impact testing: Izod and Charpy tests • Fatigue and creep phenomena • **Applications:** Quality control, material specification	1	25%
III	**Ferrous & Non-Ferrous Materials** **Topics:** • Iron-carbon diagram: phases, transformations • Plain carbon steels: low, medium, high carbon steels • Alloy steels: tool steels, stainless steels • Cast irons: gray, white, malleable, nodular • Non-ferrous metals: aluminum, copper, alloys • **Applications:** Automotive, construction, manufacturing	1	25%
IV	**Heat Treatment & Advanced Materials**	1	25%

	Topics: • Heat treatment processes: annealing, normalizing, hardening, tempering • Surface hardening: carburizing, nitriding • Polymers: types, properties, processing • Ceramics: properties and applications • Composite materials: types and characteristics • **Applications:** Tool manufacturing, aerospace, automotive		

Textbooks:

- Primary: *Material Science and Engineering* — Dr. V. D. Kodgire
- Primary: *Engineering Materials* — R. K. Rajput

Reference books:

- *Material Science and Engineering: An Introduction* — William D. Callister
- *Engineering Metallurgy* — R. A. Higgins
- *Mechanical Metallurgy* — George E. Dieter
- *A Textbook of Material Science* — Er. R. K. Singal

Online Platforms:

- SWAYAM/NPTEL: "Material Science" courses by IITs
- edX: "Materials Science" by MIT

PRACTICAL LIST:

Section A: Material Preparation & Examination

1. Specimen Preparation: Cutting, grinding, polishing of metals
2. Microstructure Examination: Using optical microscope
3. Grain Size Measurement: Using ASTM grain size chart
4. Specimen Etching: Using different etchants

Section B: Mechanical Testing

5. Tensile Test: On UTM for mild steel and aluminum
6. Hardness Test: Brinell, Rockwell, Vickers methods
7. Impact Test: Izod and Charpy tests
8. Bend Test: For ductility assessment

Section C: Heat Treatment

9. Annealing: Effect on microstructure and hardness
10. Normalizing: Comparison with annealing
11. Hardening and Tempering: Of tool steel
12. Jominy End-Quench Test: Hardenability study

Section D: Non-Metallic Materials

13. Polymer Identification: Simple tests
14. Ceramic Properties: Density, porosity measurement
15. Composite Material Preparation: Simple hand layup
16. Material Selection Exercise: Using case studies

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SEMESTER-III

COURSE CODE: DME301

COURSE NAME: STRNGTH OF MATERIALS

Course Objectives:

- To understand stress, strain, and mechanical behavior of materials
- To analyze stresses and deformations in beams, shafts, and columns
- To study theories of failure and their applications
- To learn experimental methods for material strength testing
- To apply strength principles to design simple machine components

Course Outcomes: At the end of the course students shall be able to

CO1	**Calculate** stresses and strains in loaded members
CO2	**Analyze** bending and shear stresses in beams
C03	**Determine** torsional stresses in circular shafts
C04	**Evaluate** buckling loads in columns

Unit	Content	Credit	Weightage
I	**Simple Stresses & Strains** **Topics:** • Concept of stress and strain: normal, shear • Hooke's law, elasticity, Poisson's ratio • Stress-strain diagram for ductile and brittle materials • Factor of safety, working stress • Thermal stresses, compound bars • **Applications:** Axially loaded members, temperature effects	1	25%

II	**Shear Force & Bending Moment**
	Topics:
	• Types of beams and supports
	• Shear force and bending moment diagrams for:
	  ○ Cantilever beams
	  ○ Simply supported beams
	  ○ Overhanging beams
	• Point of contraflexure
	• Relationship between load, shear force and bending moment
	• **Applications:** Beam design, structural analysis
		1	25%

III	**Stresses in Beams & Torsion** **Topics:** • Theory of simple bending: assumptions, derivation • Bending stress distribution, section modulus • Shear stress distribution in beams • Torsion of circular shafts: solid and hollow • Power transmitted by shafts • **Applications:** Shaft design, machine elements	1	25%
IV	**Columns & Combined Stresses** **Topics:**	1	25%

	• Columns: short and long columns • Euler's theory, Rankine's formula • Combined bending and direct stresses • Principal stresses and strains • Theories of failure: maximum principal stress, maximum shear stress • **Applications:** Machine frames, structural columns		

Textbooks:

- Primary: *Strength of Materials* — R. S. Khurmi
- Primary: *Strength of Materials* — B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain

Reference books:

- *Mechanics of Materials* — R. C. Hibbeler
- *Strength of Materials* — S. Ramamrutham
- *Strength of Materials* — D. S. Prakash Rao
- *A Textbook of Strength of Materials* — R. K. Bansal

Online Platforms:

- SWAYAM/NPTEL: "Strength of Materials" courses by IITs
- edX: "Mechanics of Materials" by Georgia Tech

PRACTICAL LIST:

Section A: Tension & Compression Tests

1. Tensile Test: On mild steel using UTM
    - Determination of yield point, ultimate strength, percentage elongation
2. Compression Test: On concrete cubes
3. Proof Stress Determination: For materials without yield point
4. Stress-Strain Curve Plotting: From test data

Section B: Hardness & Impact Tests

5. Hardness Tests: Brinell, Rockwell, Vickers
6. Impact Test: Izod and Charpy tests
    - Comparison of impact strength for different materials
7. Spring Testing: Determination of stiffness

Section C: Beam Testing

8. Deflection Test: On simply supported beam
    - Verification of beam deflection formula
9. Shear Force Diagram: Experimental verification
10. Bending Moment Diagram: Experimental verification
11. Beam Deflection: Using dial gauges

Section D: Torsion & Column Tests

12. Torsion Test: On circular shafts
- Determination of modulus of rigidity

13. Column Test: Buckling of columns
- Verification of Euler's formula

14. Helical Spring Test: Under axial load
15. Universal Testing Machine: Demonstration of various tests

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COURSE CODE: DME302

COURSE NAME: MANUFACTURING PROCESS-I

Course Objectives:

- To understand fundamental manufacturing processes and their principles
- To study metal casting processes and their applications
- To learn various forming processes for metal shaping
- To understand welding processes and their industrial applications
- To develop practical skills in basic manufacturing operations

Course Outcomes: At the end of the course students shall be able to

CO1	**Identify** different manufacturing processes and their applications
CO2	**Explain** casting processes and prepare sand molds
C03	**Demonstrate** various metal forming operations
C04	**Perform** basic welding operations safely

Unit	Content	Credit	Weightage
I	**Introduction to Manufacturing & Casting** **Topics:** • Classification of manufacturing processes • Pattern making: materials, types, allowances • Molding sands: properties, testing • Molding processes: green sand, dry sand, core sand • Melting furnaces: cupola, electric arc, induction • Casting defects and remedies • **Applications:** Automotive components, machine parts	1	25%
II	**Special Casting Processes** **Topics:** • Die casting: hot chamber, cold chamber • Investment casting (lost wax process) • Centrifugal casting: true, semi, vertical • Continuous casting • Shell molding • **Applications:** Mass production, precision components	1	25%
III	**Metal Forming Processes** **Topics:** • Hot working vs cold working • Forging: open die, closed die, drop forging • Rolling: hot rolling, cold rolling • Extrusion: direct, indirect • Wire drawing, tube drawing • Sheet metal operations: blanking, piercing, bending • **Applications:** Structural sections, automotive parts	1	25%
IV	**Joining Processes** **Topics:** • Welding: classification	1	25%

	• Gas welding: Oxy-acetylene welding • Arc welding: SMAW, GTAW, GMAW • Resistance welding: spot, seam, projection • Brazing and soldering • Adhesive bonding • **Applications:** Fabrication, repair, assembly		

Textbooks:

- Primary: *Manufacturing Technology* — P. N. Rao
- Primary: *Production Technology* — R. K. Jain

Reference books:

- *Manufacturing Processes* — Myron L. Begeman & B. H. Amstead
- *Manufacturing Science* — Amitabha Ghosh & Ashok Kumar Mallik
- *Workshop Technology* — W. A. J. Chapman
- *Fundamentals of Modern Manufacturing* — Mikell P. Groover

Online Platforms:

- SWAYAM/NPTEL: "Manufacturing Processes" courses by IITs
- edX: "Manufacturing Process Control" by MIT

PRACTICAL LIST:

Section A: Foundry Practice

1. Pattern Making: Preparation of simple pattern with allowances
2. Sand Testing: Moisture content, permeability, strength tests
3. Mold Preparation: Green sand molding for simple pattern
4. Core Making: Preparation of dry sand cores
5. Melting & Pouring: Demonstration using furnace

Section B: Forming Operations

6. Forging: Open die forging exercise
7. Sheet Metal Work: Development of simple objects
8. Bending Operation: Using bending tools
9. Wire Drawing: Demonstration
10. Press Operation: Simple blanking operation

Section C: Welding Practice

11. Gas Welding: Edge preparation and butt joint
12. Arc Welding: Lap joint and tee joint
13. Spot Welding: Demonstration
14. Brazing: Joining of two metal pieces
15. Welding Defects: Identification and prevention

Section D: Special Processes

16. Investment Casting: Wax pattern making
17. Die Casting: Demonstration
18. Extrusion: Demonstration on plastic material
19. Safety Demonstration: Personal protective equipment
20. Project Work: Manufacture of simple component

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COURSE CODE: DME303

COURSE NAME: FLUID MECHANICS AND HYDRAULIC MACHINES

Course Objectives:

- To understand fundamental properties and behavior of fluids
- To study fluid statics, dynamics, and flow measurement techniques
- To analyze flow through pipes and channels
- To learn working principles of hydraulic machines: pumps and turbines
- To develop skills in fluid mechanics experimentation and data analysis

Course Outcomes: At the end of the course students shall be able to

CO1	**Apply** fluid properties and principles to engineering problems
CO2	**Calculate** forces on submerged surfaces and buoyancy effects
C03	**Analyze** fluid flow using continuity, energy, and momentum equations
C04	**Measure** flow rate using various flow measurement devices

Unit	Content	Credit	Weightage
I	**Fluid Properties & Fluid Statics** **Topics:** • Properties of fluids: density, viscosity, surface tension • Pressure measurement: manometers, pressure gauges • Hydrostatic forces on submerged surfaces • Buoyancy and flotation • Stability of floating bodies • **Applications:** Dam design, ship stability, pressure vessels	1	25%
II	**Fluid Dynamics & Flow Measurement** **Topics:** • Types of fluid flow: steady/unsteady, laminar/turbulent • Continuity equation, Bernoulli's equation • Venturimeter, orifice meter, pitot tube • Flow through pipes: major and minor losses • Darcy-Weisbach equation, Moody's chart • **Applications:** Pipe network design, flow measurement	1	25%
III	**Hydraulic Pumps** **Topics:** • Classification of pumps • Centrifugal pumps: working principle, components • Performance characteristics: head, discharge, efficiency • Cavitation and NPSH • Reciprocating pumps: working principle • **Applications:** Water supply, irrigation, industrial processes	1	25%

IV	**Hydraulic Turbines & Hydraulic Systems** **Topics:** • Classification of turbines • Impulse turbines: Pelton wheel • Reaction turbines: Francis, Kaplan • Performance characteristics • Hydraulic systems: accumulators, presses • **Applications:** Hydroelectric power, industrial power transmission	1	25%

Textbooks:

- Primary: *Fluid Mechanics and Hydraulic Machines* — R. K. Bansal
- Primary: *Hydraulics and Fluid Mechanics* — P. N. Modi & S. M. Seth

Reference books:

- *Fluid Mechanics* — Frank M. White
- *A Textbook of Fluid Mechanics and Hydraulic Machines* — R. K. Rajput
- *Engineering Fluid Mechanics* — K. L. Kumar
- *Hydraulic Machines* — Jagdish Lal

Online Platforms:

- SWAYAM/NPTEL: "Fluid Mechanics" courses by IITs
- edX: "Fluid Mechanics" by MIT

PRACTICAL LIST:

Section A: Fluid Properties & Statics

1. Viscosity Measurement: Using Saybolt/Ford cup viscometer
2. Bernoulli's Theorem: Verification using Bernoulli's apparatus
3. Metacentric Height: Determination for floating bodies
4. Hydrostatic Pressure: On submerged surfaces

Section B: Flow Measurement

5. Venturimeter: Calibration and coefficient determination
6. Orifice Meter: Coefficient of discharge measurement
7. Pitot Tube: Velocity measurement in pipe
8. Reynolds Experiment: Demonstration of laminar and turbulent flow

Section C: Pipe Flow & Losses

9. Major Losses: Friction factor determination in pipes
10. Minor Losses: Sudden expansion/contraction, bends
11. Flow Visualization: Using dye injection
12. Notches & Weirs: Discharge measurement

Section D: Hydraulic Machines

13. Centrifugal Pump: Performance characteristics test
14. Reciprocating Pump: Performance test
15. Pelton Wheel Turbine: Performance characteristics
16. Francis Turbine: Performance test
17. Hydraulic Ram: Demonstration
18. Gear Oil Pump: Performance test

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SEMESTER-IV

COURSE CODE: DME401

COURSE NAME: MANUFACTURING PROCESS-II

Course Objectives:

- To understand advanced machining processes and machine tools
- To study precision machining, grinding, and finishing operations
- To learn about modern manufacturing processes and automation
- To understand metrology and quality control in manufacturing
- To develop skills in operating conventional and CNC machines

Course Outcomes: At the end of the course students shall be able to

CO1	**Operate** conventional machine tools: lathe, milling, drilling
CO2	**Perform** grinding and finishing operations
C03	**Understand** CNC machining basics and programming
C04	**Apply** metrology principles for quality control

Unit	Content	Credit	Weightage
I	**Conventional Machining - I (Turning)** **Topics:** • Lathe machine: construction, specifications, accessories • Lathe operations: turning, facing, taper turning, threading • Cutting tools: materials, geometry, tool holders • Cutting parameters: speed, feed, depth of cut • Work holding devices: chucks, centers, faceplates • **Applications:** Shafts, pins, bushings, threaded components	1	25%
II	**Conventional Machining - II (Milling & Drilling)** **Topics:** • Milling machine: types, construction, attachments • Milling operations: plain, face, slot, gear cutting • Drilling machine: types, operations • Broaching and shaping machines basics • Cutting fluids: types and applications • **Applications:** Gears, slots, keyways, complex profiles	1	25%
III	**Precision Machining & Finishing** **Topics:** • Grinding machines: surface, cylindrical, centerless • Grinding wheels: specifications, selection, dressing • Superfinishing processes: honing, lapping, polishing • Jigs and fixtures: principles and design basics • Surface finish measurement and control • **Applications:** Precision components, dies, molds	1	25%
IV	**Modern Manufacturing & CNC** **Topics:** • CNC machines: components, working principles	1	25%

	• CNC programming: G-codes, M-codes, manual programming • Non-traditional machining: EDM, ECM, laser cutting • Introduction to automation in manufacturing • Quality control in manufacturing • **Applications:** Complex profiles, mass production		

Textbooks:

- Primary: *Manufacturing Technology: Machine Tools* — P. N. Rao
- Primary: *Workshop Technology* — W. A. J. Chapman

Reference books:

- *Machine Tools* — H. C. Pandey & C. K. Singh
- *Production Engineering* — P. C. Sharma
- *CNC Machines* — P. M. Agrawal
- *Metrology* — R. K. Jain

Online Platforms:

- SWAYAM/NPTEL: "Machine Tools" and "CNC Programming" courses
- edX: "Manufacturing Systems" by MIT

PRACTICAL LIST:

Section A: Lathe Operations

1. Plain Turning: Between centers
2. Step Turning: Multiple diameters on shaft
3. Taper Turning: Using compound rest and taper attachment
4. Thread Cutting: External V-thread
5. Knurling Operation: Diamond and straight patterns

Section B: Milling & Drilling

6. Plain Milling: Using horizontal milling machine
7. Face Milling: Using vertical milling machine
8. Slot Milling: Cutting keyways and slots

9.Gear Cutting: Spur gear using dividing head

10.Drilling Operations: Through holes, blind holes, tapping

Section C: Grinding & Finishing

11. Surface Grinding: Square block finishing
12. Cylindrical Grinding: External grinding of shaft
13. Tool Grinding: Sharpening of lathe tools
14. Honing Operation: On cylindrical bore
15. Surface Finish Measurement: Using profilometer

Section D: CNC & Special Operations

16. CNC Turning: Simple program execution
17. CNC Milling: Profile milling exercise
18. EDM Demonstration: Wire-cut EDM operation
19. Jig & Fixture Design: Simple fixture preparation
20. Final Project: Complete component manufacturing

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COURSE CODE: DME402

COURSE NAME: MECHANICAL MEASUREMENTS AND METROLOGY

Course Objectives:

- To understand fundamental concepts of measurement and metrology
- To learn various measuring instruments and their applications
- To study limits, fits, tolerances, and gauges
- To understand surface roughness measurement and geometric dimensioning
- To develop skills in precision measurement and quality control

Course Outcomes: At the end of the course students shall be able to

CO1	**Use** various measuring instruments accurately
CO2	**Interpret** engineering drawings with tolerances and fits
C03	**Perform** dimensional and geometrical measurements
C04	**Apply** principles of limits, fits, and tolerances

Unit	Content	Credit	Weightage

I	**Fundamentals of Metrology & Linear Measurement**
	Topics:
	• Introduction to metrology: need, objectives, classification
	• Standards of measurement: line, end, wavelength standards
	• Errors in measurement: types, causes, minimization
	• Linear measuring instruments:
	  ○ Steel rule, calipers
	  ○ Vernier caliper, micrometer
	  ○ Height gauge, depth gauge
	  ○ Slip gauges, gauge blocks
	• **Applications:** Workshop measurements, quality inspection
		1	25%

II	**Angular Measurement, Limits, Fits & Tolerances** **Topics:** • Angular measuring instruments: protractor, sine bar, bevel protractor • Limits, fits, and tolerances: terminology • Types of fits: clearance, interference, transition • Tolerance systems: hole basis, shaft basis • ISO system of limits and fits • Selective assembly • **Applications:** Assembly design, interchangeability	1	25%
III	**Comparators & Gauges** **Topics:** • Comparators: mechanical, pneumatic, electrical, optical • Limit gauges: plug, ring, snap, thread gauges • Gauge design: Taylor's principle • Surface plates and accessories • Measurement of screw threads	1	25%

	• Gear measurement basics • **Applications:** Mass production inspection, quality control		
IV	**Advanced Metrology & Quality Control** **Topics:** • Surface roughness: parameters, measurement methods • Coordinate Measuring Machine (CMM) basics • Geometric Dimensioning and Tolerancing (GD&T) basics • Optical measuring instruments: profile projector, tool maker's microscope • Introduction to statistical quality control • Calibration of instruments • **Applications:** Precision engineering, automotive, aerospace	1	25%

Textbooks:

- Primary: *Engineering Metrology* — R. K. Jain
- Primary: *Mechanical Measurements* — R. K. Rajput

Reference books:

- *Metrology and Measurement* — Anand K. Bewoor & Vinay A. Kulkarni
- *Engineering Metrology and Measurements* — N. V. Raghavendra & L. Krishnamurthy
- *Mechanical Measurements* — Thomas G. Beckwith & Roy D. Marangoni
- *A Textbook of Metrology* — M. Mahajan

Online Platforms:

- SWAYAM/NPTEL: "Metrology" courses by IITs
- edX: "Measurement Systems" courses

PRACTICAL LIST:

Section A: Linear & Angular Measurement

1. Vernier Caliper: Measurement of internal, external, depth dimensions
2. Micrometer: Measurement of shaft diameter, thickness
3. Slip Gauges: Building of given dimensions, wringing technique
4. Height Gauge: Measurement and marking on surface plate
5. Sine Bar: Measurement of taper angle

Section B: Limits, Fits & Gauges

6. Limit Gauges: Use of plug and ring gauges
7. Tolerance Measurement: Using comparator
8. Fit Determination: For given assembly
9. Thread Measurement: Using thread micrometer and gauges
10. Gear Measurement: Using gear tooth vernier

Section C: Surface & Form Measurement

11. Surface Roughness: Measurement using surface roughness tester
12. Straightness/Flatness: Using dial gauge and surface plate
13. Roundness Measurement: Using V-blocks and dial indicator
14. Profile Projector: Measurement of profile and contours
15. Tool Maker's Microscope: Measurement of small components

Section D: Advanced Measurements

16. Optical Flat: Measurement of flatness using monochromatic light

17. Auto-collimator: Measurement of small angles
18. Pneumatic Comparator: Air gauge demonstration
19. CMM Demonstration: Basic operation
20. Calibration Exercise: Of measuring instrument

COURSE CODE: DME403

COURSE NAME: COMPUTER FUNDAMENTALS AND PROGRAMMING

Course Objectives:

- To understand computer fundamentals and architecture
- To learn programming concepts and problem-solving techniques
- To develop basic programming skills using Python language
- To apply programming to solve engineering problems
- To prepare students for CAD/CAM and automation technologies

Course Outcomes: At the end of the course students shall be able to

CO1	**Explain** computer architecture and components
CO2	**Apply** algorithmic thinking to solve problems
C03	**Write** Python programs for engineering applications
C04	**Use** data structures and functions in programming

Unit	Content	Credit	Weightage
I	**Computer Fundamentals & Problem Solving** **Topics:** • Computer generations and classifications • Computer architecture: CPU, memory, I/O devices • Number systems: binary, octal, hexadecimal • Algorithms and flowcharts • Problem-solving approaches • Introduction to operating systems • **Applications:** Understanding computer systems in manufacturing	1	25%
II	**Python Programming Basics** **Topics:** • Introduction to Python: features, installation • Python IDE and interactive mode • Basic syntax, variables, data types • Input/output operations • Operators: arithmetic, relational, logical • Conditional statements: if, if-else, nested if • **Applications:** Simple calculations, decision making	1	25%
III	**Control Structures & Functions** **Topics:** • Looping statements: while, for loops • Loop control statements: break, continue, pass • Functions: definition, parameters, return values • Built-in functions and modules • Recursion basics	1	25%

	• Scope of variables • **Applications:** Iterative calculations, modular programming		
IV	**Data Structures & Engineering Applications** **Topics:** • Lists, tuples, dictionaries • Strings and string operations • File handling: reading, writing, appending • Introduction to databases and SQL basics • Simple engineering applications: o Stress calculations o Temperature conversions o Statistical analysis • **Applications:** Data processing, engineering calculations	1	25%

Textbooks:

- Primary: *Computer Fundamentals and Programming in C* — Reema Thareja
- Primary: *Python Programming: A Modern Approach* — Vamsi Kurama

Reference books:

- *Let Us Python* — Yashavant Kanetkar
- *Computer Fundamentals* — P. K. Sinha
- *Python for Engineers* — Dr. R. R. Patil
- *Introduction to Computers* — Peter Norton

Online Platforms:

- SWAYAM/NPTEL: "Programming in Python" courses by IITs
- Coursera: "Python for Everybody" by University of Michigan
- edX: "Introduction to Computer Science" by Harvard

COURSE CODE: DME404

COURSE NAME: RENEWABLE ENERGY SYSTEMS

Course Objectives:

- To understand global energy scenario and need for renewable energy
- To study various renewable energy sources and their conversion technologies
- To analyze solar, wind, biomass, and other renewable energy systems
- To learn energy storage methods and hybrid systems
- To evaluate renewable energy systems from mechanical engineering perspective

Course Outcomes: At the end of the course students shall be able to

CO1	**Explain** different renewable energy sources and their potential
CO2	**Analyze** solar thermal and photovoltaic systems
C03	**Evaluate** wind energy systems and their components
C04	**Describe** biomass energy conversion technologies

Unit	Content	Credit	Weightage
I	**Introduction to Renewable Energy** **Topics:** • Global energy scenario and environmental concerns	1	25%

	• Classification of energy sources: conventional vs non-conventional • Renewable energy potential in India and worldwide • Energy conservation and energy efficiency basics • Government policies and incentives for renewable energy • Carbon footprint and climate change basics • **Applications:** Energy planning, sustainable development		
II	**Solar Energy Systems** **Topics:** • Solar radiation: measurement, estimation • Solar thermal systems: flat plate collectors, evacuated tube collectors • Solar water heating systems: design and components • Solar photovoltaic systems: working principle, types of cells • PV system components: modules, inverters, batteries • Solar cooking, solar drying applications • **Applications:** Domestic and industrial heating, rural electrification	1	25%
III	**Wind & Biomass Energy** **Topics:** • Wind energy: principles, power in wind • Wind turbines: horizontal axis, vertical axis • Wind turbine components: rotor, gearbox, generator • Site selection and wind resource assessment • Biomass energy: sources, classification • Biomass conversion technologies: combustion, gasification, biogas • **Applications:** Grid-connected systems, decentralized power	1	25%
IV	**Other Renewable Sources & Energy Storage** **Topics:** • Hydro energy: small hydro, micro hydro systems • Geothermal energy: principles and applications • Ocean energy: tidal, wave, OTEC basics • Fuel cells: working principles, types • Energy storage: batteries, pumped storage, flywheels • Hybrid renewable energy systems • **Applications:** Remote area electrification, backup systems	1	25%

Textbooks:

- Primary: *Non-Conventional Energy Sources* — G. D. Rai
- Primary: *Renewable Energy Sources* — Dr. B. H. Khan

Reference books:

- *Renewable Energy: Power for a Sustainable Future* — Godfrey Boyle

- *Solar Energy: Principles of Thermal Collection and Storage* — S. P. Sukhatme
- *Wind Energy: Theory and Practice* — S. A. Abbasi & N. Abbasi
- *Biomass Energy Systems* — D. L. Klass

Online Platforms:

- SWAYAM/NPTEL: "Renewable Energy Engineering" courses by IITs
- edX: "Renewable Energy" by Delft University
- Coursera: "Renewable Energy and Green Building" by University of Toronto

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SMESTER-V

COURSE CODE: DME501

COURSE NAME: HEAT TRANSFER

Course Objectives:

- To understand fundamental modes of heat transfer
- To analyze conduction heat transfer in various geometries
- To study convection heat transfer principles and correlations
- To learn radiation heat transfer basics
- To apply heat transfer principles to heat exchanger design
- To develop experimental skills in heat transfer measurement

Course Outcomes: At the end of the course students shall be able to

CO1	**Solve** conduction heat transfer problems in solids
CO2	**Calculate** convection heat transfer coefficients
C03	**Analyze** radiation heat exchange between surfaces
C04	**Design** simple heat exchangers for given applications

Unit	Content	Credit	Weightage

I	**Fundamentals & Conduction**
	Topics:
	• Modes of heat transfer: conduction, convection, radiation
	• Fourier's law of heat conduction
	• Thermal conductivity of materials
	• One-dimensional steady-state conduction:
	  ○ Plane wall
	  ○ Cylinder
	  ○ Sphere
	• Composite walls and cylinders
	• Electrical analogy: thermal resistance
	• **Applications:** Insulation design, wall heat loss calculation
		1	25%

II	**Convection Heat Transfer** **Topics:** • Newton's law of cooling • Natural and forced convection • Boundary layer concept • Dimensionless numbers: Reynolds, Prandtl, Nusselt, Grashof • Empirical correlations for convection • Heat transfer coefficient calculation • **Applications:** Cooling of electronic components, heat sinks	1	25%
III	**Radiation & Heat Exchangers** **Topics:** • Thermal radiation fundamentals • Black body radiation, Stefan-Boltzmann law	1	25%

	• View factor and radiation exchange • Heat exchangers: classification • LMTD method for heat exchanger analysis • NTU-effectiveness method introduction • **Applications:** Solar collectors, furnace design, HVAC systems		
IV	**Applications & Extended Surfaces** **Topics:** • Fins: types, effectiveness, efficiency • Transient heat conduction basics • Heat transfer with phase change: boiling, condensation • Heat pipes working principle • Insulation materials and their selection • **Applications:** Heat sink design, thermal management	1	25%

Textbooks:

- Primary: *Heat and Mass Transfer* — R. K. Rajput
- Primary: *Heat Transfer* — P. K. Nag

Reference books:

- *Fundamentals of Heat and Mass Transfer* — Incropera & DeWitt
- *Heat Transfer* — J. P. Holman
- *Engineering Heat Transfer* — W. S. Janna
- *Heat Transfer: Principles and Applications* — B. K. Dutta

Online Platforms:

- SWAYAM/NPTEL: "Heat Transfer" courses by IITs
- edX: "Heat Transfer" by IIT Bombay

PRACTICAL LIST:

Section A: Conduction Experiments

1. Thermal Conductivity Measurement:
   - Of metal rod using linear heat conduction apparatus
   - Of insulating material using guarded hot plate
2. Composite Wall Heat Transfer:
   - Through composite slab
   - Temperature distribution measurement
3. Thermal Contact Resistance:
   - Measurement between metal surfaces

Section B: Convection Experiments

4. Natural Convection:
   - From vertical cylinder
   - From horizontal cylinder
5. Forced Convection:
   - Inside circular tube
   - Across cylinder in cross-flow
6. Heat Transfer Coefficient:
   - Determination for different surfaces
   - Effect of surface roughness

Section C: Radiation & Phase Change

7. Stefan-Boltzmann Constant:

- Determination using radiation apparatus

8. Emissivity Measurement:
   - Of different surfaces
9. Boiling Heat Transfer:
   - Pool boiling demonstration
10. Condensation Heat Transfer:
    - Film condensation observation

Section D: Heat Exchangers & Applications

11. Parallel Flow Heat Exchanger:
    - Performance testing
12. Counter Flow Heat Exchanger:
    - Performance comparison with parallel flow
13. Shell and Tube Heat Exchanger:
    - Demonstration and basic calculations
14. Heat Pipe Demonstration:
    - Working principle verification

COURSE CODE: DME502

COURSE NAME: MACHINE DESIGN-1

Course Objectives:

- To understand fundamental principles of machine design
- To study design considerations for various machine elements
- To learn design procedures for shafts, keys, couplings, and fasteners
- To develop skills in selecting appropriate materials and standards
- To apply design principles to practical engineering problems

Course Outcomes: At the end of the course students shall be able to

CO1	**Apply** design considerations and principles to machine elements
CO2	**Design** shafts and keys for various loading conditions
C03	**Select** appropriate couplings for power transmission
C04	**Design** threaded fasteners and welded joints

Unit	Content	Credit	Weightage
I	**Fundamentals of Machine Design** **Topics:** • Introduction to machine design process • Design considerations: strength, rigidity, wear, corrosion • Materials selection in machine design • Standards in design: BIS, ISO, AGMA • Manufacturing considerations in design • Factor of safety and design philosophies • **Applications:** General machine component design	1	25%
II	**Design of Shafts & Keys** **Topics:**	1	25%

	• Types of shafts: transmission, line, spindle
	• Shaft materials and manufacturing processes
	• Design of shafts under:
	  ○ Twisting moment only
	  ○ Bending moment only
	  ○ Combined twisting and bending moments
	• ASME code for shaft design
	• Keys: types, design considerations
	• Keyways and their effect on shaft strength
	• **Applications:** Power transmission systems		

III	**Couplings & Fasteners**
	Topics:
	• Types of couplings: rigid, flexible
	• Design of:
	  ○ Muff couplings
	  ○ Flange couplings
	  ○ Oldham couplings
	  ○ Universal joints
	• Threaded fasteners: terminology, materials
	• Design of bolts under:
	  ○ Tensile loading
	  ○ Shear loading
	  ○ Eccentric loading
	• Locking arrangements for fasteners
	• **Applications:** Machine assembly and power transmission
		1	25%

IV	**Welded & Riveted Joints**
	Topics:
	• Welded joints: types, advantages, disadvantages
	• Strength calculations for:
	  ○ Butt welds
	  ○ Fillet welds
	  ○ Parallel and transverse fillet welds
	• Riveted joints: types, failure modes
	• Design of riveted joints for:
	  ○ Lap joints
	  ○ Butt joints
	• Eccentrically loaded welded and riveted joints
	• **Applications:** Structural and pressure vessel design
		1	25%

Textbooks:

- Primary: *Machine Design* — R. S. Khurmi & J. K. Gupta
- Primary: *Design of Machine Elements* — V. B. Bhandari

Reference books:

- *Machine Design: An Integrated Approach* — Robert L. Norton
- *Mechanical Engineering Design* — Joseph E. Shigley
- *A Textbook of Machine Design* — P. C. Sharma & D. K. Aggarwal
- *Design Data Handbook* — K. Mahadevan & K. Balaveera Reddy

Online Platforms:

- SWAYAM/NPTEL: "Machine Design" courses by IITs
- edX: "Machine Design" by MIT

COURSE CODE: DME503

COURSE NAME: CAD/CAM

Course Objectives:

- To understand fundamental concepts of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM)
- To develop skills in 3D modeling and assembly using CAD software
- To learn basic CNC programming and CAM software operations
- To integrate CAD/CAM systems for manufacturing applications
- To understand rapid prototyping and additive manufacturing basics

Course Outcomes: At the end of the course students shall be able to

CO1	**Create** 3D solid models and assemblies using CAD software
CO2	**Generate** engineering drawings with proper annotations
C03	**Develop** basic CNC programs using G&M codes
C04	**Simulate** machining operations using CAM software

Unit	Content	Credit	Weightage
I	**Introduction to CAD & 3D Modeling** **Topics:** • Evolution of CAD/CAM technology • CAD hardware and software components • Solid modeling concepts: features, constraints, parameters • Sketching: constraints, dimensions, relations • Feature-based modeling: extrude, revolve, sweep, loft • **Applications:** Component design, prototyping	1	25%

II	**Assembly Design & Drafting**
	Topics:
	• Assembly modeling: constraints, mates
	• Bottom-up and top-down assembly approaches
	• Bill of Materials (BOM) creation
	• Engineering drawing generation:
	  ○ Orthographic projections
	  ○ Section views
	  ○ Dimensioning and tolerancing
	  ○ Surface finish symbols
		1	25%

III	**CNC Programming Fundamentals** **Topics:** • Introduction to CNC technology • CNC machine components and axes • G-codes and M-codes (common codes) • Manual part programming for:	1	25%

	○ Turning operations ○ Milling operations • Tool path planning basics • **Applications:** CNC machining, automation		
IV	**CAM & Advanced Applications** **Topics:** • CAM software interface and workflow • Tool selection and parameter setting • Machining operations: facing, pocketing, contouring • Post-processing and NC code generation • Introduction to: ○ Rapid Prototyping (3D Printing) ○ Reverse Engineering ○ Computer-Aided Inspection • **Applications:** Rapid manufacturing, quality control	1	25%

Textbooks:

- Primary: *CAD/CAM: Concepts and Applications* — Alavala Chennakesava
- Primary: *Mastering CAD/CAM* — Ibrahim Zeid

Reference books:

- *CAD/CAM: Principles and Applications* — P. N. Rao
- *Computer Aided Design and Manufacturing* — Dr. Sadhu Singh
- *CNC Programming Handbook* — Peter Smid
- *SolidWorks for Designers* — Sham Tickoo

Online Platforms:

- SWAYAM/NPTEL: "CAD/CAM" courses by IITs
- edX: "Autodesk CAD/CAM" specialization

PRACTICAL LIST:

Section A: CAD Modeling (Using SolidWorks/Fusion 360)

1. Basic Sketching: Constraints and dimensions practice
2. Part Modeling: Simple mechanical components
   - Shaft with keyway
   - Flange coupling
   - Gear blank
   - Bearing housing
3. Advanced Features:
   - Pattern creation (linear, circular)
   - Shell, draft, fillet operations
   - Configurations and design tables
4. Surface Modeling: Basic surface creation

Section B: Assembly & Drafting

5. Assembly Creation:
   - Plummer block assembly
   - Screw jack assembly
   - Machine vice assembly
6. Engineering Drawings:

- Single part drawing with tolerances
- Assembly drawing with balloons and BOM
- Sectional views and detailed views

Section C: CNC Programming

8. CNC Turning Program:
   - Simple shaft turning
   - Taper turning and threading
9. CNC Milling Program:
   - Pocket milling
   - Contour milling
   - Drilling pattern
10. CNC Simulation: Using CNC simulator software
11. Tool Path Verification: Visual verification of programs

Section D: CAM & Integration

12. CAM Software Operation:
    - Importing CAD model
    - Setting up machining operations
    - Tool path generation and simulation
13. Post Processing: Generating machine-specific code
14. 3D Printing Demonstration:
    - STL file generation
    - Slicer software operation

COURSE CODE: DME504

COURSE NAME: INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Objectives:

- To understand fundamental concepts of industrial engineering and management
- To study work study and productivity improvement techniques
- To learn production planning and inventory control methods
- To understand quality management systems and statistical process control
- To develop knowledge of safety management and industrial legislation
- To learn basics of industrial cost analysis and project management

Course Outcomes: At the end of the course students shall be able to

CO1	**Apply** work study techniques to improve productivity
CO2	**Plan** production schedules using basic planning tools
C03	**Implement** inventory control methods for efficient material management
C04	**Apply** quality control techniques in manufacturing processes

Unit	Content	Credit	Weightage
I	**Introduction to Industrial Engineering & Work Study** **Topics:** • Evolution and scope of industrial engineering • Productivity: concepts, measurement, improvement techniques	1	25%

	• Work study: method study and work measurement • Time study: procedure, equipment, rating, allowances • Work sampling and predetermined time standards • Ergonomics: basic principles and applications • **Applications:** Productivity improvement, workplace optimization		

II	**Production Planning & Inventory Control**
	Topics:
	• Types of production systems: job, batch, mass, continuous
	• Production planning and control functions
	• Forecasting techniques: qualitative and quantitative (simple moving average)
	• Aggregate planning basics
	• Master production scheduling
	• Inventory management:
	  ○ EOQ model
	  ○ ABC analysis
	  ○ VED analysis
	  ○ Material requirements planning (MRP) basics
	• **Applications:** Manufacturing scheduling, material management
		1	25%

III	**Quality Management & Statistical Process Control**
	Topics:
	• Quality concepts: definitions, dimensions of quality
	• Quality management systems: ISO 9001 basics
	• Total Quality Management (TQM) principles
	• Statistical Process Control (SPC):
	  ○ Control charts: X-bar & R charts, p-charts
	  ○ Process capability analysis basics
	• Seven quality tools (QC tools)
	• Six Sigma basics (DMAIC overview)
	• **Applications:** Quality improvement, process control
		1	25%

IV	**Industrial Safety, Costing & Project Management**
	Topics:
	• Industrial safety: importance, accident prevention
	• Safety regulations: Factories Act basics
	• Industrial cost analysis: elements of cost
	• Break-even analysis
	• Key performance indicators (KPIs)
	• Project management basics:
	  ○ Network techniques: CPM and PERT
	  ○ Gantt charts
	• Maintenance management: types of maintenance
		1	25%

	• **Applications:** Safety management, cost control, project planning		

Textbooks:

- Primary: *Industrial Engineering and Management* — O. P. Khanna
- Primary: *Industrial Engineering and Production Management* — Martand Telsang

Reference books:

- *Industrial Engineering and Management* — Banga & Sharma
- *Production and Operations Management* — S. N. Chary
- *Industrial Engineering* — S. C. Sharma
- *Introduction to Work Study* — ILO Publications

Online Platforms:

- SWAYAM/NPTEL: "Industrial Engineering" courses by IITs
- Coursera: "Operations Management" courses
- edX: "Introduction to Operations Management" by IIM Bangalore

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SEMESTER-VI

COURSE CODE: DME504

COURSE NAME: INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Objectives:

- To understand fundamental concepts of industrial engineering and management
- To study work study and productivity improvement techniques
- To learn production planning and inventory control methods
- To understand quality management systems and statistical process control
- To develop knowledge of safety management and industrial legislation
- To learn basics of industrial cost analysis and project management

Course Outcomes: At the end of the course students shall be able to

CO1	**Apply** work study techniques to improve productivity
CO2	**Plan** production schedules using basic planning tools
C03	**Implement** inventory control methods for efficient material management
C04	**Apply** quality control techniques in manufacturing processes

Unit	Content	Credit	Weightage
I	**Introduction to Industrial Engineering & Work Study** **Topics:** • Evolution and scope of industrial engineering • Productivity: concepts, measurement, improvement techniques • Work study: method study and work measurement • Time study: procedure, equipment, rating, allowances • Work sampling and predetermined time standards • Ergonomics: basic principles and applications • **Applications:** Productivity improvement, workplace optimization	1	25%

II	**Production Planning & Inventory Control**
	Topics:
	• Types of production systems: job, batch, mass, continuous
	• Production planning and control functions
	• Forecasting techniques: qualitative and quantitative (simple moving average)
	• Aggregate planning basics
	• Master production scheduling
	• Inventory management:
	  ○ EOQ model
	  ○ ABC analysis
	  ○ VED analysis
	  ○ Material requirements planning (MRP) basics
		1	25%

	• **Applications:** Manufacturing scheduling, material management		

III	**Quality Management & Statistical Process Control**
	Topics:
	• Quality concepts: definitions, dimensions of quality
	• Quality management systems: ISO 9001 basics
	• Total Quality Management (TQM) principles
	• Statistical Process Control (SPC):
	  ○ Control charts: X-bar & R charts, p-charts
	  ○ Process capability analysis basics
	• Seven quality tools (QC tools)
	• Six Sigma basics (DMAIC overview)
	• **Applications:** Quality improvement, process control
		1	25%

IV	**Industrial Safety, Costing & Project Management**
	Topics:
	• Industrial safety: importance, accident prevention
	• Safety regulations: Factories Act basics
	• Industrial cost analysis: elements of cost
	• Break-even analysis
	• Key performance indicators (KPIs)
	• Project management basics:
	  ○ Network techniques: CPM and PERT
	  ○ Gantt charts
	• Maintenance management: types of maintenance
	• **Applications:** Safety management, cost control, project planning
		1	25%

Textbooks:

- Primary: *Industrial Engineering and Management* — O. P. Khanna
- Primary: *Industrial Engineering and Production Management* — Martand Telsang

Reference books:

- *Industrial Engineering and Management* — Banga & Sharma
- *Production and Operations Management* — S. N. Chary
- *Industrial Engineering* — S. C. Sharma
- *Introduction to Work Study* — ILO Publications

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SEMESTER-VI

COURSE CODE: DME601

COURSE NAME: AUTOMOBILE ENGINEERING

Course Objectives:

- To understand fundamental components and working of automobile systems
- To study different types of automobile engines and their performance characteristics
- To learn about transmission systems, steering, suspension, and braking systems
- To understand electrical systems, safety features, and emission control technologies
- To develop skills in automobile component identification, testing, and basic troubleshooting
- To learn about alternative fuel vehicles and modern automotive technologies

Course Outcomes: At the end of the course students shall be able to

CO1	**Identify** and **explain** various automobile systems and their functions
CO2	**Analyze** engine performance parameters and calculate efficiency
C03	**Describe** working principles of transmission, steering, and suspension systems
C04	**Perform** basic automobile component testing and measurements

Unit	Content	Credit	Weightage
I	**Introduction & Engine Systems** **Topics:** • Classification of automobiles • Vehicle layout and chassis components • Engine classification and working principles • Engine components: cylinder, piston, connecting rod, crankshaft, valves • Engine systems: fuel, cooling, lubrication • Engine performance parameters: power, torque, efficiency • **Applications:** Engine selection, performance analysis	1	25%
II	**Transmission & Running Systems** **Topics:** • Clutch: types, construction, working • Gearbox: manual, automatic, CVT • Propeller shaft and universal joints • Final drive and differential • Steering systems: types, geometry • Suspension systems: springs, shock absorbers • **Applications:** Power transmission, vehicle dynamics	1	25%
III	**Braking, Electrical & Safety Systems** **Topics:** • Braking systems: mechanical, hydraulic, pneumatic	1	25%

	• ABS and EBD basics • Electrical systems: battery, alternator, starter motor • Lighting and signaling systems • Safety systems: seat belts, airbags, crumple zones • Vehicle body types and materials • **Applications:** Vehicle safety, electrical troubleshooting		
IV	**Modern Technologies & Maintenance** **Topics:** • Emission control systems: catalytic converter, EGR • Alternative fuels: CNG, LPG, hydrogen • Electric vehicles: components, working • Hybrid vehicles: series, parallel, series-parallel • Automotive electronics: sensors, actuators, ECU basics • Preventive maintenance and service schedules • **Applications:** Modern vehicle technology, maintenance	1	25%

Textbooks:

- Primary: *Automobile Engineering* — Kirpal Singh (Volumes 1 & 2)
- Primary: *Automobile Engineering* — R. K. Rajput

Reference books:

- *Automotive Mechanics* — William H. Crouse & Donald L. Anglin
- *Automobile Engineering* — Dr. N. K. Giri
- *Automotive Technology: Principles, Diagnosis, and Service* — James D. Halderman
- *Internal Combustion Engines* — V. Ganesan

Online Resources:

- SWAYAM/NPTEL: "Automobile Engineering" courses by IITs
- edX: "Automotive Engineering" by Chalmers University

PRACTICAL LIST:

Section A: Engine Systems

1. Engine Disassembly & Assembly:
   - Four-stroke petrol engine
   - Identification of components
   - Measurement of engine parameters
2. Engine Performance Testing:
   - Morse test on multi-cylinder engine
   - Heat balance sheet preparation
   - Fuel consumption measurement
3. Engine Systems Study:
   - Cooling system components
   - Lubrication system components
   - Fuel supply system (carburetor/FI)

Section B: Transmission & Chassis

4. Clutch Assembly:
   - Single plate clutch disassembly

- Component identification and measurement

5. Gearbox Study:
   - Manual gearbox disassembly
   - Gear ratio calculation
   - Synchronizer mechanism study
4. Steering & Suspension:
   - Steering geometry measurement
   - McPherson strut disassembly
   - Leaf spring and coil spring study

Section C: Braking & Electrical

7. Braking System:
   - Drum brake assembly
   - Disc brake assembly
   - Master cylinder and wheel cylinder
8. Electrical System Testing:
   - Battery testing: specific gravity, voltage
   - Alternator output measurement
   - Starter motor operation study
9. Lighting System:
   - Headlight alignment
   - Circuit testing and troubleshooting

Section D: Modern Systems & Testing

10. Emission Testing:
    - Using exhaust gas analyzer
    - CO, HC, NOx measurement
    - Smoke density measurement
11. Wheel Alignment:
    - Camber, caster, toe-in measurement
    - Alignment equipment demonstration
12. Diagnostic Tools:
    - OBD-II scanner demonstration
    - Basic fault code reading
13. Vehicle Inspection:
    - Safety inspection checklist
    - Basic troubleshooting exercise

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COURSE CODE: DME602

COURSE NAME: MAINTENANCE ENGINEERING

Course Objectives:

- To understand the importance and principles of maintenance engineering
- To study different types of maintenance strategies and their applications
- To learn preventive, predictive, and corrective maintenance techniques
- To develop skills in condition monitoring and fault diagnosis
- To understand maintenance planning, scheduling, and cost control
- To learn safety procedures and documentation in maintenance operations

Course Outcomes: At the end of the course students shall be able to

CO1	**Explain** different maintenance strategies and their selection criteria
CO2	**Implement** preventive maintenance schedules for industrial equipment
C03	**Apply** condition monitoring techniques for predictive maintenance
C04	**Perform** basic troubleshooting and corrective maintenance

Unit	Content	Credit	Weightage

I	**Fundamentals of Maintenance Engineering**
	Topics:
	• Importance and objectives of maintenance
	• Types of maintenance:
	  ○ Breakdown maintenance
	  ○ Preventive maintenance
	  ○ Predictive maintenance
	  ○ Condition-based maintenance
	• Total Productive Maintenance (TPM) concepts
	• Maintenance organization structures
	• Maintenance cost analysis and budgeting
	• **Applications:** Industrial plant maintenance planning
		1	25%

II	**Preventive & Predictive Maintenance**
	Topics:
	• Preventive maintenance schedules and checklists
	• Lubrication management: types, methods, schedules
	• Inspection techniques and procedures
	• Predictive maintenance tools:
	  ○ Vibration analysis basics
	  ○ Thermography applications
	  ○ Oil analysis
	  ○ Ultrasonic testing
	• Condition monitoring parameters
	• **Applications:** Machinery health monitoring
		1	25%

III	**Maintenance of Mechanical Systems**
	Topics:
	• Maintenance of:
	  ○ Bearings and lubrication systems
	  ○ Gears and gearboxes
	  ○ Belt and chain drives
	  ○ Pumps and compressors
	  ○ Valves and piping systems
	• Alignment procedures: shaft, belt, coupling
	• Balancing of rotating equipment basics
	• **Applications:** Industrial equipment maintenance
		1	25%

IV	**Maintenance Management & Safety** **Topics:** • Maintenance planning and scheduling • Work order systems • Spare parts management and inventory control • Computerized Maintenance Management Systems (CMMS) • Safety in maintenance operations • Lockout-Tagout (LOTO) procedures • Maintenance documentation and records • **Applications:** Maintenance department management	1	25%

Textbooks:

- Primary: *Maintenance Engineering and Management* — S. K. Srivastava
- Primary: *Industrial Maintenance Management* — S. K. Hajra Choudhury

Reference books:

- *Maintenance Engineering Handbook* — Lindley R. Higgins
- *Reliability Engineering and Maintenance* — B. S. Dhillon
- *Plant Maintenance Engineering* — N. C. Kothari
- *Total Productive Maintenance* — Japan Institute of Plant Maintenance

Online Resources:

- SWAYAM/NPTEL: "Maintenance Engineering" courses by IITs
- Coursera: "Maintenance Management" courses
- edX: "Asset Management and Maintenance" by Delft University

PRACTICAL LIST:

Basic Maintenance Procedures

1. Bearing Maintenance:
   - Bearing removal and installation techniques
   - Clearance measurement and adjustment
   - Lubrication procedures
2. Alignment Exercises:
   - Shaft alignment using dial indicators
   - Laser alignment demonstration
   - Belt and pulley alignment

1. Gearbox Maintenance:

- Disassembly and assembly of gearbox
- Gear wear inspection
- Backlash measurement

Section B: Condition Monitoring

4. Vibration Analysis:
   - Vibration measurement using portable analyzer
   - Spectrum analysis basics
   - Fault diagnosis from vibration patterns
5. Thermographic Inspection:
   - Thermal camera operation
   - Hot spot detection
   - Electrical and mechanical component inspection
6. Lubricant Analysis:
   - Oil sampling procedures
   - Viscosity measurement
   - Particle contamination analysis

Section C: Equipment Maintenance

7. Pump Maintenance:
   - Centrifugal pump disassembly
   - Impeller inspection and repair
   - Mechanical seal replacement
8. Compressor Maintenance:
   - Reciprocating compressor valve inspection
   - Intercooler maintenance
   - Safety valve testing
7. Valve Maintenance:
   - Gate valve overhaul
   - Control valve calibration
   - Packing replacement

Section D: Safety & Management

10. Safety Procedures:
    - Lockout-Tagout (LOTO) demonstration
    - Confined space entry procedures
    - Working at height safety
11. Maintenance Planning:
    - Work order preparation
    - Maintenance schedule development
    - Spare parts requirement planning
12. CMMS Operation:
    - Basic CMMS software operation
    - Maintenance record keeping
    - Report generation

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COURSE CODE: DME603

COURSE NAME: INDUSTRY 4.0 AND IOT

Course Objectives:

- To understand the evolution and core concepts of Industry 4.0
- To learn about Internet of Things (IoT) and its applications in manufacturing
- To study smart sensors, connectivity, and data analytics in industrial context
- To explore digital twin, additive manufacturing, and cyber-physical systems
- To develop basic skills in IoT implementation for industrial applications
- To understand the impact of Industry 4.0 on future manufacturing careers

Course Outcomes: At the end of the course students shall be able to

CO1	**Explain** the four industrial revolutions and Industry 4.0 pillars
CO2	**Identify** IoT components and their applications in manufacturing
C03	**Interface** sensors with microcontrollers for data acquisition
C04	**Understand** cloud platforms and data analytics basics

Unit	Content	Credit	Weightage

I	**Introduction to Industry 4.0 & Industrial IoT**
	Topics:
	• Evolution of industrial revolutions (1.0 to 4.0)
	• Pillars of Industry 4.0:
	  ○ Internet of Things (IoT)
	  ○ Big Data and Analytics
	  ○ Artificial Intelligence and Machine Learning
	  ○ Cloud Computing
	• Cyber-Physical Systems (CPS)
	• Smart Factory concepts
	• Digital transformation in manufacturing
	• **Applications:** Smart manufacturing, predictive maintenance
		1	25%

II	**IoT Components & Connectivity**
	Topics:
	• IoT architecture: perception, network, application layers
	• Sensors and actuators for industrial applications
	• Microcontrollers (Arduino, Raspberry Pi basics)
	• Communication protocols:
	  ○ Wired: Ethernet, RS-485
	  ○ Wireless: Wi-Fi, Bluetooth, Zigbee, LoRa
	  ○ Industrial: Modbus, OPC-UA basics
	• Edge computing vs cloud computing
	• IoT platforms overview
	• **Applications:** Remote monitoring, condition monitoring
		1	25%

III	**Data Analytics & Smart Manufacturing** **Topics:** • Data acquisition from sensors • Basics of data analytics for manufacturing • Predictive maintenance using sensor data • Digital Twin concepts and applications • Additive Manufacturing (3D Printing) in Industry 4.0 • Augmented Reality (AR) and Virtual Reality (VR) in industry • Robotics and automation in smart factories • **Applications:** Quality control, production optimization	1	25%
IV	**Implementation & Future Trends** **Topics:** • IoT project development lifecycle • Security considerations in industrial IoT • Case studies: Successful Industry 4.0 implementations • Skill requirements for Industry 4.0 workforce • Impact on jobs and required competencies • Sustainability and green manufacturing • Future trends: 5G, AI, Blockchain in manufacturing • **Applications:** Career planning, technology adoption	1	25%

Textbooks:

- Primary: *Industry 4.0: The Industrial Internet of Things* — Alasdair Gilchrist
- Primary: *Getting Started with the Internet of Things* — Cuno Pfister

Reference books:

- *Industry 4.0: Managing the Digital Transformation* — Alp Ustundag & Emre Cevikcan
- *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases* — David Hanes et al.
- *Smart Factory: Industry 4.0 and Beyond* — Dr. John Soldatos
- *Introduction to Industry 4.0 and Industrial IoT* — Dr. Sudip Misra et al.

Online Resources:

- SWAYAM/NPTEL: "Industry 4.0" courses by IITs
- Coursera: "Industry 4.0: How to Revolutionize Your Business" by University of London
- edX: "IoT Fundamentals" by Curtin University

PRACTICAL LIST:

Section A: Basic IoT Setup

1. Arduino/Raspberry Pi Introduction:
   - Basic interfacing and programming
   - LED blinking and button input
   - Serial communication setup
2. Sensor Interfacing:
   - Temperature and humidity sensor (DHT11/DHT22)
   - Proximity sensor (Ultrasonic/HC-SR04)

- Vibration sensor (SW-420)
- Current sensor (ACS712)

1. Actuator Control:
   - Relay module control
   - DC motor control using L293D
   - Servo motor control

Section B: Connectivity & Communication

4. Wireless Communication:
   - Wi-Fi connectivity setup
   - Bluetooth module interfacing
   - ESP8266/ESP32 based projects
5. Data Transmission:
   - MQTT protocol implementation
   - HTTP requests for data sending
   - Real-time data streaming
6. Cloud Integration:
   - ThingSpeak platform setup
   - Data visualization on cloud
   - Alert and notification setup

Section C: Industrial Applications

7. Condition Monitoring System:
   - Vibration monitoring for motors
   - Temperature monitoring for machines
   - Predictive maintenance prototype
8. Smart Inventory System:
   - RFID based component tracking
   - Barcode scanning integration
   - Inventory level monitoring
7. Energy Monitoring:
   - Power consumption monitoring
   - Energy efficiency calculations
   - Automated power control

Section D: Advanced Projects

10. Digital Twin Prototype:
    - Physical system modeling
    - Real-time data mapping
    - Virtual representation creation
11. Smart Safety System:
    - Gas leakage detection
    - Fire detection and alert
    - Emergency shutdown system
12. Quality Control System:
    - Product counting and sorting
    - Dimension verification
        - Defect detection basics